REMARKS

As requested by the Examiner, Applicants have amended the abstract to delete "a production line and" therefrom. Also enclosed herewith is a new substitute specification including "clean" and "marked-up" copies including the section headings required by the Examiner. No new matter has been added.

In order to expedite the prosecution of the present application, Claim 17 has been canceled and replaced by Claims 18 and 19, respectively, which more particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Specifically speaking, Claim 18 requires that a recrystallized state be formed in the drawn heat-exchanger tube material prior to cutting and Claim 19 requires that the cutting step be performed before the recrystallization step. No new matter has been added.

Claims 2-5 and 17 have been rejected under 35 USC 103(a) as being unpatentable over Uhlmann et al '566 in view of Uhlmann et al '449 and further in view of Franks. Applicants respectfully traverse this ground of rejection and urge reconsideration in light of the following comments.

The presently claimed invention is directed to a method of manufacturing lamellar U-shaped heat-exchanger tubes which comprises the steps of producing a drawn heat-exchanger tube material made of a nonferrous metal, cooling the drawn heat-exchanger tube material horizontally in a round open-top container, uncoiling the drawn heat-exchanger tube material from the container, straightening the uncoiled drawn heat-exchanger tube material, forming a recrystallized state in the drawn heat-exchanger tube material by annealing and subsequently cooling the drawn heat-exchanger tube material, cutting the drawn heat-exchanger tube material having the recrystallized state to form tube portions of a desired length and bending the tube portions in a U-shape to form the lamellar U-shaped heat-exchanger tubes. In an alternate embodiment of the present invention, the drawn heat-exchanger tube material is cut to form the tube portions prior to the

formation of the crystallized state in the tube portions. Support for the language of the recrystallization is provided in the first paragraph on page 8 of the clean copy of the substitute specification.

As explained previously, during the manufacture of conventional lamellar U-shaped heat-exchanger tubes, thin-wall tubes are produced in a coil form from a tube manufacturer and are uncoiled by the heat-exchanger manufacturer, cut to the desired length and bent to form the U-shaped tubes. When the tubes are uncoiled by the heat-exchanger manufacturer, they subjected to an acceleration and braking process which makes the thin-wall tubes susceptible to buckling. Due to the delivered tubes being typically tightly wound into a coil in order to reduce the transport volume of the container, problems are created during the handling of the tubes once they are removed from the transport containers and bend-straightening procedures, carried out under longitudinal tensile stresses, to return the tubes to a straight condition result in a reduction in the average outside diameter of the tubes and a reduction in the wall thickness thereof in the outer expansion region, an increase in wall thickness in the inner compression region and flattening and ovalization of its cross-sectional area. Moreover, softening and recrystallization, which occur during the bright-annealing of the highly hardened heat-exchanger tubes, which are in the form of tightly wound coils, lead to an adaption of the tubes' cross-sections to the geometrically constrained conditions of the coil and, therefore, to changes in the shape of the tubes' cross-section and in the layer diameters of individual turns.

The present invention avoids these problems by providing that a tube-drawing operation be immediately followed by a economical method for the production of the hairpin tubes. This reduces the cost of the transport and handling of the coiled and relatively sensitive semi-finished tubes. The advantages achieved by the present invention reside in the fact that the otherwise usual winding of the hardened heat-

exchanger tubes to form multi-layered narrow-radius coils that are limited in weight, and the stack-wise annealing of those coils in a bright-annealing furnace are circumvented and the disadvantages of tightly wound tubes, such as changes in cross-sectional shape by ovalization, wall thickness changes, and homogeneous stress distribution and a large amount of waste lengths being generated are also avoided. Once again it is respectfully submitted that the prior art cited by the Examiner does not disclose the presently claimed invention.

Uhlmann et al '566 discloses the interconnecting of several lengths of tubes, either in advance by welding or brazing, or on-line by hollow plugs, and the feeding of the tubes through an annealing furnace, a jacketing station and a cutter whereby a flushing gas such as air, oxygen-enriched air or an inert gas are sucked through the respective training end. As admitted by the Examiner, this reference does not disclose coiling the drawn heat-exchanger tube material horizontally in a round open-top container, uncoiling the drawn heat-exchanger tube material from the container or bending the tube portions in a U-shape. Since Uhlmann et al '566 is not concerned with the formation of lamellar heat exchanger tubes which are bent in a hairpin shape, the problems associated therewith are not appreciated by this reference.

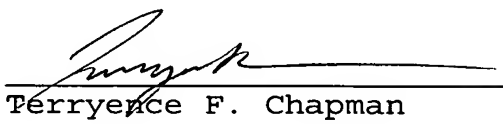
Uhlmann et al '449 shows the drawing of copper tubing through a die by means of a rotating drum to which the front end of the tube is fastened and may remain fastened as the drawn tubing is coiled on the drum, or the front is released, so that the frictional engagement of multiple coils on the drum provide for pulling. This reference has been cited by the Examiner as disclosing the coiling of the drawn heat-exchanger tube material horizontally in an open-top container and uncoiling the drawn heat-exchanger tube material from the container. However, once again there is no suggestion in this reference regarding the problems associated with the manufacture of lamellar heat-exchanger tubes which are bent in

a hairpin shape and the avoidance of these problems by following the presently claimed process steps which provide a softening and recrystallization state after the annealing and subsequent cooling of the drawn heat-exchanger tube material to eliminate the problems associated with tightly coiled and soft tubes. Therefore, this reference does not cure the deficiencies contained in the previously discussed reference.

The Franks reference discloses a method of cutting an elongated tube and apparatus therefore in which tube portions are bent in a U-shape. However, like the previously discussed references, this reference has no showing of a drawn heat-exchanger tube material being subjected to an annealing and cooling step before being bent in a U-shape to avoid the problems associated with the transport of a hardened tubing. As stated previously, the instant invention avoids the conventional problems associated with the winding of a hardened heat-exchanger tube to form multi-layered narrow-radius coils that are limited in weight, changed in cross-sectional shape in the form of ovalization, changed in wall thickness, homogeneous stress distribution and the generation of a large amount of waste lengths. Therefore, it is respectfully submitted that the presently claimed invention clearly is patentably distinguishable over the references cited by the Examiner.

The Examiner is respectfully requested to reconsider the present application and to pass it to issue.

Respectfully submitted,



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